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	Benzene	 <table border="1" style="width: 100%; text-align: center;"> <tr><td style="background-color: yellow;">Reactivity</td></tr> <tr><td style="background-color: red;">Flammability</td></tr> <tr><td style="background-color: blue;">Health (NFPA=3)</td></tr> </table>	Reactivity	Flammability
Reactivity				
Flammability				
Health (NFPA=3)				

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND THE COMPANY/ UNDERTAKING

Identification of the substance or preparation: Country of origin: CAS Number: Synonyms:	Benzene Iran (Islamic Republic of Iran) 71-43-2 BENZOL; CYCLOHEXATRIENE; BENZOLE; PHENE; PYROBENZOL; PYROBENZOLE; CARBON OIL; COAL TAR NAPHTHA; PHENTL HYDRIDE; BENZOLENE; BICARBURET OF HYDROGEN; COAL NAPHTHA; MOTOR BENZOL; ANNULENE; MINERAL NAPHTHA; (6) ANNULENE; NITRATION BENZENE; RCRA U019; UN 1114; STCC 4908110; C6H6; OHS02610; RTECS CY1400000
Company/undertaking identification	National Petrochemical Company Iran Petrochemical Commercial Company (IPCC)
Manufacturer subcontractor: Emergency phone number: Contact email: Fax: Association/Organization: Use of the substance/Preparation:	None 00982188881735 msds@petrochem-ir.net 00982188839511 None

2. COMPOSITION/INFORMATION ON INGREDIENTS

Hazardous substances: Hazardous label(s):	Benzene Flammable liquid IB having a flash point lower than 22.8 C(73 F) and having a boiling point at or above 37.8 C(100 F)
Toxicological characteristics:	Highly Toxic HUMAN CARCINOGEN Irritant substance Target organ effects
Substances present at a concentration below the minimum danger: Other component:	Toluene : max 150 PPM wt% None

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3. IDENTIFICATION OF HAZARDS

Risk phrases:

**NFPA RATINGS (SCALE 0-4): HEATH=3
FIRE=3 REACTIVITY=0**

EC CLASSIFICATION (ASSIGNED):

F Highly Flammable

T Toxic

Carcinogen Category 1

R 11-45-48/23/24/25

EC Classification may be inconsistent with independently researched data.

EMERGENCY OVERVIEW:

COLOR: Colorless to yellow

PHYSICAL FORM: liquid

ODOR: distinct odor

MAJOR HEALTH HAZARDS: potentially fatal on contact with the skin, respiratory tract irritation, skin irritation, eye irritation, blood damage, central nervous system depression, cancer hazard (in humans)

PHYSICAL HAZARDS: Extremely flammable liquid and vapor. Vapor may cause flash

Fire. Electrostatic charges may be generated by flow, agitation, etc.

Skin contact:

SHORT TERM EXPOSURE: irritation, blisters

LONG TERM EXPOSURE: tingling sensation

Inhalation :

SHORT TERM EXPOSURE: irritation, ringing in the ears, nausea, vomiting, chest pain, difficulty breathing, irregular heartbeat, headache, drowsiness, symptoms of drunkenness, disorientation, blurred vision, lung congestion, blood disorders, paralysis, convulsions, coma



LONG TERM EXPOSURE: hearing loss, visual disturbances, reproductive effects, brain damage and cancer

Eye contact:

SHORT TERM EXPOSURE: irritation
LONG TERM EXPOSURE: no information on significant adverse effects

If swallowed:

SHORT TERM EXPOSURE: nausea, vomiting, chest pain, headache, drowsiness, symptoms of drunkenness, disorientation,

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visual disturbances, lung congestion, analysis, convulsions and coma
LONG TERM EXPOSURE: impotence, cancer

Other information:

None

4. FIRST AID MEASURES

**As a general rule, in case of doubt or if symptoms persist, always call a doctor
 NEVER induce vomiting in an unconscious person.**

Skin contact :

Remove contaminated clothing, jewelry, and shoes immediately.

Wash with soap or mild detergent and large amounts of water until no evidence of Chemical remains (at least 15-20 minutes). Get medical attention, if needed

In case of exposure by inhalation:

When safe to enter area, remove from exposure. Use a bag valve mask or similar device to perform artificial respiration (rescue breathing) if needed. Keep warm and at rest. Get medical attention immediately.

In case of splashes or contact with eyes:

Wash eyes immediately with large amounts of water or normal saline, occasionally lifting upper and lower lids, until no evidence of chemical remains. Get medical attention immediately.



In case of swallowing:

Note of physician:

Contact local poison control center or physician immediately. Never make an uncurious person vomit or drink fluids. When vomiting occurs, keep head lower than hips to help prevent aspiration. If person is unconscious, turn head to side. Get medical attention immediately.

Note of physician:

For inhalation, consider oxygen. For ingestion, consider gastric lavage.

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5. FIRE FIGHTING MEASURES

Flammable class:

Extremely flammable liquid
Severe fire hazard. Moderate explosion hazard.
 Vapor/air mixtures are explosive. The vapor is heavier than air. Vapors or gases may Ignite at distant ignition sources and flash back. Electrostatic discharges may be generated by flow or agitation resulting in ignition or explosion.

Flash point: 12 f (-11 c) (cc)
Lower flammable limit: 1.2%
Upper flammable limit: 7.8%
Autoignition: 928 f (498 c)

Suitable extinguishing media:

Flammability class (osha): ib
regular dry chemical, carbon dioxide, water, regular foam

Fire fighting :

Large fires: Use regular foam or flood with fine water spray.
 Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire are out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck:

Special exposure hazards arising from the substance or preparation itself, combustion products, resulting gases:



Evacuation radius: 800 meters (1/2 mile).
Water may be ineffective.
Extremely flammable liquid. Vapor may explode if ignited in closed area.
Incomplete burning can produce carbon monoxide and carbon dioxide and other harmful products.

Special protective equipment for fire fighting :

Fire fighters should wear full bunker gear, including a positive pressure self-contained breathing apparatus.

Other information:

Keep away from sources of ignition such as heat and open flames. Keep container closed. Use with adequate ventilation.

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6. ACCIDENTAL RELEASE MEASURES

Personal precautions:

Use proper personal protective equipment. Wear chemical resistance gloves and footwear with good traction to avoid slipping. Isolate area. Keep unnecessary personal away. Ground all approved equipment used in area. Alert stand-by emergency and fire fighting personal.

Environmental precautions:

Methods for cleaning up and disposal:

Remove or shut off all ignition sources. Remove mechanically or contain on an absorbent material such as dry sand or earth. Increase ventilation if possible .wear respirator and spray with water to disperse vapors. Keep out of sewers and waterways.



Other information:

AIR RELEASE:
Reduce vapors with water spray. Stay upwind and keep out of low areas.

SOIL RELEASE:
Dig holding area such as lagoon, pond or pit for containment. Dike for later disposal. Absorb with sand or other non-combustible material.

WATER RELEASE:
Cover with absorbent sheets, spill-control pads or pillows. Apply detergents, soaps, alcohols or another surface active agent. Collect with absorbent into suitable container.
Absorb with activated carbon. Remove trapped material with suction hoses. Collect spilled material using mechanical equipment. Subject to California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65). Keep out of water supplies and sewers.

OCCUPATIONAL RELEASE:
Avoid heat, flames, sparks and other sources of ignition. Stop leak if possible without Personal risk. Reduce vapors with water spray. Small spills: Absorb with sand or other Non-combustible material. Collect spilled material in appropriate container for disposal.
Large spills: Dike for later disposal. Remove sources of ignition. Keep unnecessary people away, isolate hazard area and deny

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entry. Notify Local Emergency Planning committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800) 424-8802 (USA) or (202) 426-2675 (USA).

7. HANDLING AND STORAGE

The regulations relating to storage premises apply to workshop where the product is handled :

Handling:

Store and handle in accordance with all current regulations and standards. Subject to Storage regulation: U.S. OSHA 29 CFR 1910.106. Grounding and bonding required. Protect from physical damage. Store outside or in a detached building. Store with Flammable liquids. Keep separated from incompatible substances. Use with adequate ventilation. Do not breathe vapors. Keep away from ignition sources. Ground and bond containers when transferring materials. Wash thoroughly after handling. After this container has been emptied, it may contain flammable vapors; observe all warnings and precautions listed for this product.



Storage:

Store in a flammable liquids storage area. Store away from heat, ignition sources, and open flame in accordance with applicable regulations. Keep container closed. Outside storage is recommended.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure limit values:

BENZENE :
1 ppm OSHA TWA
5 ppm OSHA STEL 15 minute(s)
0.5 ppm OSHA action level
0.5 ppm (1.6 mg/m³) ACGIH TWA
2.5 ppm (8 mg/m³) ACGIH STEL

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0.1 ppm (0.32 mg/m3) NIOSH recommended TWA 8 hour(s)

1 ppm (3.2 mg/m3) NIOSH recommended ceiling 15 minute(s)

3.2 mg/m3 (1 ml/m3) AGS MAK 4 times/shift

5 ppm (16 mg/m3) UK OES TWA
MEASUREMENT METHOD: charcoal tube; Carbon disulfide; Gas chromatography with flame ionization detection; NIOSH III # 1500, Hydrocarbons; ALSO NIOSH III # 3700.

VENTILATION: Provide local exhaust or process enclosure ventilation system.

Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Wear splash resistant safety goggles. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: Wear appropriate chemical resistant clothing.

GLOVES: Wear appropriate chemical resistant gloves. OSHA REGULATED

SUBSTANCES: U.S. OSHA 29 CFR 1910.1028.

RESPIRATOR: The following respirators and maximum use concentrations are drawn From NIOSH and/or OSHA.

10 ppm

Any air-purifying respirator with a full facepiece and an organic vapor canister.

50 ppm

Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s).

Any air-purifying respirator with a full facepiece and a canister providing protection against this substance.

100 ppm



Any powered air-purifying respirator with a full facepiece and organic vapor cartridge(s).

1000 ppm

Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode.

For Unknown Concentrations or Immediately Dangerous to Life or Health

Any self-contained breathing apparatus that

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Exposure controls:

has a full facepiece and is operated in a Pressure-demand or other positive-pressure mode.

Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply. Escape-Any air-purifying respirator with a full facepiece and an organic vapor canister. Any self-contained breathing apparatus with a full facepiece.

Provide local and general exhaust ventilation to effectively remove and prevent build up of any vapours or mists generated from the handling of this product. Ensure that eyewash stations and safety showers are proximal to the workstation location. Equipment selection reviews and preventative maintenance programs (including leak detection and repairs) are recommended practices to minimize potential workplace exposures.

Personal protective equipment:

Use proper personal protective equipment (wear chemical resistance gloves and footwear with good traction to avoid slipping.

Eye protection:

Wear safety chemical goggles.

Respiratory protection:

NIOSH approved organic vapor cartridge respirators SCBA should be used in poorly ventilated areas. Air supplied breathing apparatus must be used when airborne concentrations may exceed the limits of the air purifying respirator used.

Hand protection:

Wear hands appropriate protective gloves to prevent skin exposure.

Skin and body protection:



Wear appropriate protective clothing to prevent skin exposure.

Health measures:

Provide local and general exhaust ventilation.

Environmental exposure controls:

OSHA 1ppm PEL ; 5 ppm STEL ; 0.5 ppm ACGIH : .5 ppm TWA: 2.5 ppm STEL



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9. PHYSICAL AND CHEMICAL PROPERTIES

General information:	benzene
Appearance (at 20°C):	Liquid
Colour:	Colourless to yellow
Odour:	Sweet, aromatic odour
Odour threshold :	12 ppm
Ionisation potential :	9.25 eV
freezing point/range (°C):	6°C (43°F)
PH (at 20°C):	Not applicable
Boiling point/range (°C):	80°C (176°F)
Flash point (°C):	-11°C
Flammability:	flammable
Auto-ignition temperature:	498°C
Explosive properties:	Vapor with air make explosive mixture Lower flammable limit: 1.2% Upper flammable limit: 7.8%
Vapour pressure (at 20°C):	75 mm Hg
Density (at 20°C):	0.8765
Solubility (at 20°C):	water solubility: 0.18 g/ml
Viscosity (40°C):	solubility: acetone, alcohol, carbon disulfide, ether, carbon tetrachloride, chloroform, acetic acid, oils, organic solvents
Evaporation rate(butyl acetate =1):	Not available
Other information:	15.1 Molecular formula : C ₆ H ₆ Molecular weight : 78.11

10. STABILITY AND REACTIVITY

Stability:	Stable at normal temperatures and pressure.
Conditions to avoid:	Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat. Keep out of water supplies and sewers.
Material to avoid:	acids, bases, halogens, oxidizing materials, metal salts INCOMPATIBILITIES: acids, bases, halogens, oxidizing materials, metal salts BENZENE: ACIDS (STRONG): Incompatible ALLYL CHLORIDE WITH

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DICHLOROETHYL ALUMINUM OR ETHYLALUMINUM SESQUICHLORIDE:

Possible explosion.

ARSENIC PENTAFLUORIDE + POTASSIUM METHOXIDE: Explosive interaction.

BASES (STRONG): Incompatible

BROMINE + IRON: Incompatible

BROMINE PENTAFLUORIDE: Fire and explosion hazard.

BROMINE TRIFLUORIDE: Possible explosion or ignition.

CHLORINE: Explosion in the presence of light.

CHLORINE TRIFLUORIDE: Violent reaction with possible explosion.

CHROMIC ANHYDRIDE (POWDERED): Ignition.

DIBORANE: Spontaneously explosive reaction in air.

DIOXYGEN DIFLUORIDE: Ignition, even at reduced temperatures.

DIOXYGENYL TETRAFLUOROBORATE: Ignition reaction.

INTERHALOGEN COMPOUNDS: Ignition or explosion.

IODINE HEPTAFLUORIDE: Ignition on contact.

IODINE PENTAFLUORIDE: Violent interaction above 50 C.

NITRIC ACID: Violent or explosive unless properly agitated and cooled.

NITRYL PERCHLORATE: Explosive interaction.

OXIDIZERS (STRONG): Fire and explosion hazard.

OXYGEN (LIQUID): Explosive mixture.

OZONE: Formation of explosive gelatinous ozone.



PERCHLORATES (METAL): Formation of explosive complex.

PERCHLORYL FLUORIDE + ALUMINUM CHLORIDE: Formation of shock sensitive compound.

PERMANGANATES + SULFURIC ACID: Possible explosion.

PERMANGANIC ACID: Explosion hazard.

PEROXODISULFURIC ACID: Explosion hazard.

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PEROXOMONOSULFURIC ACID:
Explosive interaction.
POTASSIUM PEROXIDE: Ignition.
SILVER PERCHLORATE: Formation of explosive complex.
SODIUM PEROXIDE + WATER: Ignition.
URANIUM HEXAFLUORIDE: Violent reaction.
HAZARDOUS DECOMPOSITION:
 Thermal decomposition products: oxides of carbon
POLYMERIZATION: Will not polymerize.

Hazardous decomposition products:

Upon decomposition it emits carbon monoxide, carbon dioxide and / or low molecular weight hydrocarbons.

11. TOXICOLOGICAL INFORMATION

Acute toxicity:

- LD₅₀, oral, rat (mg.kg⁻¹): 930
- LD₅₀, oral, mouse (mg.kg⁻¹): 4700
- LD₅₀, dermal (µL.kg⁻¹): > : 9400

Sub chronic – chronic toxicity:



Bone marrow is the main target of Benzene. Long term overexposure to benzene has been associated with certain types of leukemia in humans. The international Agency for research on cancer (IARC) and OSHA identify benzene as a human carcinogen. Chronic exposure of benzene has also been reported to cause adverse in blood effects including anemia. Progressive deterioration of hematopoietic function expressed as a decrease in absolute lymphocyte count is the most sensitive indicator of benzene exposure. Benzene may also cause fetotoxicity and teratogenicity. Chromosomal aberrations have been noted in animal tests.

Sensibilization:

Carcinogenicity:

The international agency for research on cancer (IARC) and and OSHA identify benzene as a human carcinogen. Long term overexposure to benzene has been associated with certain types of leukemia in humans. Benzene may pose a cancer hazard

Reproductive effects:

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and may cause adverse birth and reproductive effects. Bone marrow abnormalities, leukemia, multiple myelomas, fetotoxicity, teratogenicity (anencephaly, angulated ribs and dilated brain ventricles) have been linked to benzene exposure.

Human experience:

Other information (details of above item):

BENZENE:

IRRITATION DATA:

15 mg/24 hour(s) open skin-rabbit mild; 20 mg/24 hour(s) skin-rabbit moderate; 88 mg eyes-rabbit moderate; 2 mg/24 hour(s) eyes-rabbit severe



TOXICITY DATA:

2 pph/5 minute(s) inhalation-human LCLO; 50 mg/kg oral-man LDLO; 150 ppm/1 year (intermittent inhalation-man TCLO; 100 ppm inhalation-human TCLO; 65mg/m³/5 year(s) inhalation-human LCLO; 194 mg/kg unreported-man LDLO; 930 mg/kg oral-rat LD50; 10000 ppm/7 hour(s) inhalation-rat LC50; 1100 ug/kg intraperitoneal-rat LD50; 4700 mg/kg oral-mouse LD50; 9980 ppm inhalation-mouse LC50; 48 mg/kg skin-mouse

LD50; 340 mg/kg intraperitoneal-mouse LD50; 2 gm/kg oral-dog LDLO' 146000 m/g/m³ inhalation-dog LCLO; 170000 mg/m³ inhalation-cat LCLO' 45000 ppm/30 minute(s) inhalation-rabbit LCLO; >9400 ul/kg skin-rabbit LD50; 88 mg/kg intravenous rabbit LDLO; >9400 ul/kg skin-guinea pig LD50; 527 mg/kg intraperitoneal-guinea pig LDLO; 1400 mg/kg subcutaneous-frog LDLO; 5700 mg/kg oral-mammal LD50; 20000



ppm/5 minute(s) inhalation-mammal LCLO; 1500 mg/kg intraperitoneal-mammal LDLO; 6600 mg/kg/27 (weeks) intermittent oral-rat TDLO; 23 mg/m³/4 hour(s)-8 day(s) intermittent inhalation-rat TCLO; 300 ppm/6 hour(s)-13 week(s) intermittent inhalation rat

TCLO; 17 gm/kg/17 week(s) intermittent oral-rat TDLO; 1000 ppm/7 hour(s)-28 week(s) intermittent inhalation-rat TCLO; 500 ppm/6 hour(s)-3 week(s) intermittent



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inhalation-rat TCLO; 18 mg/kg/21 day(s)
intermittent subcutaneous-rat TDLO; 2197 mg/kg/5 day(s) intermittent subcutaneous-rat TDLO; 13536 mg/kg/12 week(s) intermittent subcutaneous-rat TDLO; 4250 mg/kg/17 week(s) intermittent oral-mouse TDLO; 300 ppm/6 hour(s)-13 week(s) intermittent inhalation-mouse TCLO; 25 ppm/6 hour(s)-5 day(s) intermittent inhalation-mouse TCLO; 10 ppm/6 hour(s)-10 week(s) intermittent inhalation-mouse TCLO; 211 ppm/6 hour(s)-7 day(s) intermittent oral-mouse TCLO; 48 ppm/6 hour(s)-14 day(s) intermittent inhalation-mouse TCLO; 2197 mg/kg/5 day(s) intermittent subcutaneous-mouse TDLO; 100 ppm/6 hour(s)-72 week(s) intermittent inhalation-mouse TCLO; 500 mg/m³/3 hour(s)-13 week(s) intermittent inhalation-rabbit TCLO; 100 ppm/6 hour(s)-3 week(s) intermittent inhalation-pig TCLO
CARCINOGEN STATUS: OSHA: Carcinogen; NTP: Known Human Carcinogen; IARC: Human sufficient Evidence, Animal Sufficient Evidence, Group 1; ACGIH: A1 confirmed Human Carcinogen; EC: Category 1; TRGS 905: K 1 Numerous case reports and series have suggested a relationship between exposure to benzene and the occurrence of various types of leukemia. Several case-control studies have also shown increased odds ratios for exposure to benzene, but mixed exposure patterns and poorly defined exposures render their interpretation difficult. Three independent cohort studies have demonstrated an increased incidence of acute nonlymphocytic leukemia in workers exposed to benzene.



LOCAL EFFECTS:
Irritant: inhalation, skin, eye
ACUTE TOXICITY LEVEL:
Highly Toxic: dermal absorption
Moderately Toxic: ingestion
Slightly Toxic: inhalation
TARGET ORGANS: immune system

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(blood), central nervous system
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: blood system disorders, immune system disorders or allergies
TUMORIGENIC DATA:
200 mg/m³ inhalation-man TCLO/78 week(s) intermittent; 10 ppm inhalation-human TCLO/8 hour(s)-10 year(s) intermittent; 52 gm/kg oral-rat TDLO/52 week(s) intermittent; 1200 ppm inhalation-rat TCLO/6 hour(s)-10 week(s) intermittent; 18250 mg/kg oral-mouse TDLO/2 year(s) continuous; 300 ppm inhalation-mouse TCLO/6 hour(s)-16 week(s) intermittent; 1200 gm/kg skin-mouse TDLO/49 week(s) intermittent; 1200 mg/kg intraperitoneal-mouse TDLO/8 week(s) intermittent; 600 mg/kg subcutaneous-mouse TDLO/17 week(s) intermittent; 670 mg/kg parenterl-mouse TDLO/19 week(s) intermittent; 150 ppm inhalation-human TC/15 minute(s)-8 year(s) intermittent; 52 gm/kg oral-rat TD/1 year(s) intermittent; 10 gm/kg oral-rat TD/52 week(s)intermittent; 600 mg/m³ inhalation-man TC/4 year(s) intermittent; 150 ppm inhalation-man TC/11 year(s) intermittent; 1200 ppm inhalation-mouse TC/6 hour(s)-10 week(s) intermittent; 2400 mg/kg oral-mouse TD/8 week(s) intermittent; 8 ppb inhalation-human TC/4 week(s) intermittent; 10 mg/m³ inhalation-human TC/11 year(s) intermittent; 300 ppm inhalation-mouse TC/6 hour(s)-16 week(s) intermittent
MUTAGENIC DATA
Mutation in microorganisms-Salmonella typhimurium 10 ppm (-S9): specific locus test Drosophila melanogaster oral 11250 umol/L; sex chromosome loss and non disjunctiondrosophila melanogaster oral 7500 ppm; sex chromosome loss and non disjunction –Drosophila melanogaster multiple 27000 ppm; mutation in microorganisms –Saccharomyes cerevisae 549 mg/L (+S9); mutation in microorganisms – saccharomyes

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cerevisae 275 mg/L (-S9) gene conversion and mitotic recombination – Saccharomyes cerevisae 275 mg/L; sex chromosome loss and non disjunction – Aspergillus nidulans 35000 ppm; other mutation test systems – grasshopper inhalation 14 pph 16 hour(s); other mutation test systems – non-mammalian species intraperitoneal 75 gm/kg; DNA inhibition – human leulocyte 2200 umol/L; DNA inhibition – human HeLa cell 2200umol/L; other mutation test systems – human lymphocyte 5 umol/L; cytogenetic analysis– human inhalation 125 ppm 1 year(s); cytogenetic analysis – human leukocte 1 mmol/L 72 hour(s); cytogenetic analysis – human lymphocyte 1 mg/L; cytogenetic analysis –human unreported 10 ppm 4 week(s); sister chromatid exchange – human lymphocyte 200 umol/L; mutation in mammalian somatic cells – human lymphocyte 1 gm/L; micronucleus test – rat inhalation 1 ppm 6 hour(s); unscheduled DNA synthesis – rat liver 1 mmol/L; DNA inhibition – rat inhalation 400 ppm; other mutation test systems –rat liver 1 mmol/L; other mutation test systems – rat bone marrow 1 mmol/L; othermutation test systems – rat subcutaneous 1 gm/L; other mutation test system – rat subcutaneous 2200 mg/kg; cytogenetic analysis – rat inhalation 300 mg/m3 16 week(s) – intermittent; cytogenetic analysis – rat inhalation 300 mg/m3 16 week(s) – intermittent; cytogenetic analysis – rat subcutaneous 2400 mg/kg 12 day(s)-intermittent; cytogenetic analysis rat intraperitoneal 234 mg/kg; cytogenetic analysis - rat oral 39060 ug/kg; sister chromatid exchange-rat inhalation 3 ppm 6 hour(s); sister chromatid exchange-rat leukocyte 1 mmol/L; micronucleus test – mouse embryo 12500 nmol/L; micronucleus test – mouse subcutaneous 440 mg/kg; micornucleus test – mouse intraperitoneal 264 mg/kg 24 hour(s); micronucleus test – mouse inhalation 10 mouse oreal 40 mg/kg ppm 6



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hour(s); mutation in microorganisms – mouse lymphocyte 62500 ug/L (+S9); mutation in microorganisms – mouse embryo 2500 mg/L (+S9); morphological transformation mouse embryo 1 gm/L; morphological transformation – mouse fibroblast 150 gm/L; DNA damage – mouse lymphocyte 3840 umol/L; DNA adduct – mouse intraperitoneal 2640 mg/kg 3 day(s) – continuous; other mutation test systems-mouse oral 2 gm/kg; other mutation test systems – mouse other cell types 5 mmol/L; DNA inhibition – mouse oral 20 gm/kg; other mutation test systems-mouse lymphocyte 10 mmol/L; DNA inhibition – mouse intraperitoneal 880 mg/kg; DNA inhibition – mouse inhalation 3000 ppm 4 hour(s)-continuous; DNA inhibition-mouse bone marrow 3 mmol/L; sister chromatid exchange – mouse inhalation 10 ppm 6 hour(s); sister chromatid exchange – mouse intraperitoneal 5 gm/kg; cytogenetic analysis – mouse oral 20 mg/kg; cytogenetic analysis – mouse intraperitoneal 264 mg/kg 3 day(s)-continuous; cytogenetic analysis – mouse inhalation 3000 ppm; dominant lethal test – mouse oral 1 mg/kg; dominant lethal test – mouse intraperitoneal 5 mg/kg; mutation in mammalian somatic cells – mouse lymphocyte 12500 ug/L; mutation in mammalian somatic cells – mouse inhalation 40 ppb 6 week(s)-continuous; morphological transformation – hamster embryo 100 ug/L; DNA damage – hamster ovary 17 mmol/L; cytogenetic analysis – hamster lung 550 mg/L; cytogenetic analysis – hamster ovary 600 mg/L; sister chromatid exchange – hamster ovary 750 mg/L; sex chromosome loss and non disjunction – hamster liver 62500 ug/L; sex chromosome loss and non disjunction – hamster embryo 30 umol/L; mutation in

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mammalian somatic cells – hamster embryo
10 umol/L; DNA damage – rabbit
subcutaneous 2344 mg/kg; DNA inhibition –
rabbit subcutaneous 2 gm/kg; other
mutation test systems – rabbit bone marrow
1 mmol/L; other mutation test systems – cat
bone marrow 1 mmol/L; cytogenetic analysis
– rabbit subcutaneous 8400 mg/kg.

REPRODUCTIVE EFFECTS DATA:
670 mg/m³ inhalation-rat TCLO/24 hour(s)
15 day(s) pre pregnancy/1-22 day(s)
pregnant female continuous; 56600 ug/m³
inhalation-rat TCLO/24 hour(s) 1-22 day(s)
pregnant female continuous; 50 ppm
inhalation-rat TCLO hour(s) 7-14 day(s)
pregnant
female continuous; 150 ppm inhalation-rat
TCLO/24 hour(s) 7-14 day(s) pregnant
female
continuous; 9 gm/kg oral-mouse TDLO 6-15
day(s) pregnant female continuous; 12
gm/kg oral-mouse TDLO 6-15 day(s)
pregnant female continuous; 6500 mg/kg
oral mouse TDLO 8-12 day(s) pregnant
female continuous; 500 ppm inhalation-
mouse TCLO/7 hour(s) 6-15 day(s) pregnant
female continuous; 500 mg/m³ inhalation-
mouse TCLO/12 hour(s) 6-15 day(s)
pregnant female continuous; 5 ppm
inhalation-mouse
TCLO 6-15 day(s) pregnant female
continuous; 20 ppm inhalation-mouse
TCLO/6 hour(s) 6-15 day(s) pregnant female
continuous; 5 mg/kg intraperitoneal-mouse
TDLO 1
day(s) male; 219 mg/kg intraperitoneal-
mouse TDLO 14 day(s) pregnant female
Continuous; 1100 mg/kg subcutaneous-
mouse TDLO 12 day(s) pregnant female
Continuous; 7030 mg/kg subcutaneous-
mouse TDLO 12-13 day(s) pregnant female
Continuous; 13200 ug/kg intravenous-mouse
TDLO 13-16 day(s) pregnant female
Continuous; 4 gm/kg parenteral-mouse
TDLO 12 day(s) pregnant female
Continuous; 1 gm/m³ inhalation-rabbit
TCLO/24 hour(s) 7-20 day(s) pregnant
female continuous; 1 gm/m³ inhalation-
rabbit TCLO/24 hour(s) 7-20 day(s)

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pregnant female
continuous

ADDITIONAL DATA: May cross the placenta. Alcohol may enhance the toxic effects.

Interactions with drugs may occur.



Use of stimulants such as epinephrine may cause cardiac arrhythmias.

HEALTH EFFECTS:

INHALATION:

ACUTE EXPOSURE:

BENZENE: Concentrations of 3000 ppm may cause respiratory tract irritation; more severe exposures may result in pulmonary edema. Systemic effects are mainly on the central nervous system and depend on exposure time and concentration. No effects were noted at 25 ppm for 8 hours; signs of intoxication began at 50-150 ppm, within 5 hours; at 500-1500 ppm, within 1 hour; were severe at 7500 ppm, within 30-60 minutes; and 20000 ppm was fatal within 5-10 minutes. Effects may include nausea, vomiting, headache, dizziness, drowsiness, weakness, sometimes preceded by a brief period of exhilaration or euphoria, irritability, malaise, confusion, ataxia, staggering, weak, rapid pulse, chest pain and tightness with breathlessness, pallor, cyanosis of the lips and fingertips and tinnitus. In severe exposures there may be blurred vision, shallow, rapid breathing, delirium, cardiac arrhythmias, unconsciousness, deep anesthesia, paralysis, and coma characterized by motor restlessness, tremors and hyperreflexia, sometimes preceded by convulsions. Polyneuritis may occur and there may be persistent nausea, anorexia, muscular weakness, headache, drowsiness, insomnia, and agitation. Nervous irritability, breathlessness, and unsteady gait may persist for 2-3 weeks; a peculiar skin color and cardiac distress may persist for 4 weeks. Liver and kidney effects may occur, but are usually mild, temporary impairments. Chromosomal damage has been found after exposure to toxic levels. Although generally hematotoxicity is not a

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significant concern in acute exposure, delayed hematological effects, including anemia and thrombocytopenia, have been reported, as have petechial hemorrhages, spontaneous internal bleeding and secondary infections. In fatal exposures, death may be due to asphyxia, central nervous system depression, cardiac or respiratory failure and circulatory collapse, or occasionally, sudden ventricular fibrillation. It may occur within a few minutes to several hours, or cardiac arrhythmia may occur at anytime within 24 hours.



Also, death from central nervous system, respiratory or hemorrhagic complications may occur up to 5 days after exposure.

Pathologic findings have included respiratory inflammation with edema and hemorrhage of the lungs, renal congestion, cerebral edema, and extensive petechial hemorrhages in the brain, pleurae, pericardium, urinary tract, mucous membranes, and skin.



CHRONIC EXPOSURE:

BENZENE: Long term exposures cause symptoms referable to the central nervous, hematopoietic and immune systems. Early effects are vague and varied and may include headache, light-headedness, dizziness, nausea, anorexia, abdominal discomfort, and fatigue. Sore, dry throat, weakness, lethargy, malaise, drowsiness, nervousness, and irritability have also been reported. Later there may be dyspnea, pallor, slightly increased temperature, decreased blood pressure, rapid pulse, palpitations, and visual disturbances.

Dizziness when cold water is placed in the ear and hearing impairment have been reported, as have diffuse cerebral atrophy associated with ataxia, tremors and emotional lability. Workers exposed to benzene in combination with other solvents have exhibited polyneuritis. Several case reports, one of them an acute exposure, suggest the possibility that systemic exposure may be associated with retrobulbar or optic neuritis. Occasionally hemorrhages in retina

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and conjunctive occur and rarely euroretinal edema and papilledema have accompanied the retinal hemorrhages. Hematological effects vary widely and may appear after a few weeks or many years of exposure or even many years after exposure has ceased. The degree of exposure below which no blood effects will occur cannot be established with certainty. In the early stages, there may be blood clotting defects due to morphological, functional and quantitative platelet alteration with resultant bleeding from the nose and gums, easy bruising and petechiae; leukopenia with predominant lymphocytopenia or neutropenia; and anemia which may be norm chromic or macrocytic and hypo chromic. Extramedullary hematopoiesis, splenomegaly, circulating immature marrow cells, and an initial increase in leukocytes, erythrocytes and platelets have also been reported. The bone marrow may be hyper-hypo or norm plastic and does not always correlate with the peripheral blood picture. Also, the symptoms do not always parallel the laboratory findings. If treated at this stage, the effects appear reversible, although recovery may be protracted and there may be relapses. Decreased erythrocyte survival, hemolytic, capillary fragility, internal hemorrhages, iron metabolism disturbances, and hyperbilirubinemia have also been reported. Exposure to high levels for longer periods may result in aplasia and fatty degeneration of the bone marrow with pancytopenia. The most serious cases of a plastic anemia may be fatal due to hemorrhage and infection; death may occur within 3 months of diagnosis. Enormous variability in individual response, including non-dose dependent aplasia, and the finding of eosinophilia suggests that, in some cases, the blood dyscrasia may partially be an allergic reaction. Numerous case reports and series have suggested a relationship between exposure to benzene and the occurrence of various types of leukemia. Several case control studies have also shown increased odds ratios for exposure to benzene, but



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mixed exposure patterns and poorly defined exposures render their interpretation difficult. Three independent cohort studies have demonstrated an increased incidence of acute nonlymphocytic leukemia in workers exposed to benzene. Several studies have also suggested a link between occupational exposure and multiple myeloma and lymphoma, both Hodgkin's and non-Hodgkin's. Although aplastic anemia is probably the more likely consequence of long-term exposure, it is not uncommon for an individual surviving this, to go through a preleukemic phase into frank leukemia. Conversely, leukemia without precedent aplastic anemia can occur. In one study the range of time from the start of the exposure to the diagnosis of leukemia was 3-24 years. It has been suggested that the chromosomal aberrations which can arise in peripheral blood and bone marrow cells and persist for a long time after exposure ceases, may be associated with the increased incidence of leukemia. The immunosuppressive effect has also been suggested as being associated with the leukemogenesis. Adverse effects on the immunological system have been shown to make rabbits more susceptible to tuberculosis and pneumonia and may explain why the terminal event in some cases of benzene intoxication may be overwhelming infection. Exposed mice exhibited a tendency toward induction of neoplasms, mainly carcinomas, at various sites. Menstrual disturbances have been reported more frequently in exposed women. Testicular damage has been reported in rats, Rabbits and guinea pigs. Some animal studies have demonstrated embryo/fetotoxicity, sometimes at levels as low as 10 ppm and the potential for teratogenic effects such as decreased body weight and skeletal variants, have also been shown. Other studies have not produced any abnormalities or embryo lethality.

SKIN CONTACT:

ACUTE EXPOSURE:

BENZENE: Direct contact may cause irritation. Effects may include erythema, a

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burning Sensation, and with prolonged contact, blistering and edema. Under normal conditions, significant signs of systemic toxicity are unlikely from skin contact alone due to the slow rate of absorption; it may however, contribute to the toxicity from inhalation. Application to guinea pigs resulted in increased dermal permeability.

CHRONIC EXPOSURE:

BENZENE: Repeated or prolonged contact defats the skin and may result in dermatitis with erythema, scaling, dryness, vesiculation, and fissuring, possibly accompanied by paresthesias of teh fingers which may persist several weeks after the dermatitis subsides.

Peripheral netitis has also been reported. Secondary infections may occur. Tests on guinea pigs indicate sensitization is possible, Although animal studies have failed to establish a relationship between skin contact and a carcinogenic effect, most of the studies were inadequate; some papillomas and hematopoietic effects have been reported.

EYE CONTACT:

ACUTE EXPOSURE:

BENZENE: May cause irritation. Vapor concentrations of 3000 ppm are very irritating, even on brief exposure. Droplets cause a moderate burning sensation but only a slight, transient corneal epithelial injury with rapid recovery.



CHRONIC EXPOSURE:

BENZENE: Repeated or prolonged exposure my cause conjunctivitis. 50% of rats exposed to 50 ppm for more than 600 hours developed cataracts.

INGESTION:

ACUTE EXPOSURE:

BENZENE: May cause local irritation and burning sensation in the mouth, throat and stomach, and hemorrhagic inflammatory lesions of the mucous membranes in contact with the liquid. Signs and symptoms of systemic intoxication may include nausea, vomiting, headache, dizziness, weakness, staggering, chest pain and tightness, followed by flushing, and a fear of



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impending death. There may be visual disturbances, tremors, convulsions, ventricular irregularities, and paralysis. Excitement, euphoria or delirium may precede weariness, fatigue, sleepiness and followed by stupor and unconsciousness, coma and death form respiratory failure. Those who survive the central nervous system effects may develop bronchitis, pneumonia, pulmonary edema, and intrapulmonary

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 Sheet 289 of 452 hemorrhages. Aspiration may cause immediate pulmonary edema and hemorrhage. The usual lethal does in humans is 10-15 milliliters, but smaller amounts have been reported to cause death. A single exposure may produce longterm effects with pancytopenia persisting up to a year.

CHRONIC EXPOSURE:

BENZENE: Daily administration to humans of 2-5 grams in olive oil caused headache, vertigo, bladder irritability, impotence, gastric disturbances, and evidence of renal congestion. In female rats treated with 132 single daily doses over 187 days, no effects were observed at 1 mg/kg; slight leukopenia at 10 mg/kg; and both leukopenia and anemia at 50 and 100 mg/kg. Oral administration to rats and mice at various does levels induced neoplasms at multiple sites in males and females. In a one year gavages study, rats given 50 or 250 mg/kg, 4-5 days/week for 52 weeks did not exhibit acute or sub acute toxic effects, but a does correlated increase of leukemias and mammary carcinomas was observed; some other tumor types were also reported. Reproductive effects have been reported in animals.



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12. ECOLOGICAL INFORMATION

Ecotoxicity:	<p>FISH TOXICITY: 9200 ug/L 96 hour(s) LC50 (Mortality) Rainbow trout, Donaldson trout (Oncorhynchus mykiss)</p> <p>INVERTEBRATE TOXICITY: 10000 ug/L 48 hour(s) EC50 (Immobilization) water flea (Daphnia magna)</p> <p>ALGAL TOXICITY: 41000 ug/L 8 hour(s) EC50 (Growth) Green algae (Selenastrum capricornutum)</p> <p>OTHER TOXICITY: 25 ug/L 24 day(s) (Residue) Wood frog (Rana sylvatica)</p>
Bio accumulative potential:	<p>FATE AND TRANSPORT:</p> <p>BIOCONCENTRATION: 4360 ug/L 24 day(s) BCF (Residue) Northern anchovy (Engraulis mordax) 97 ug/L</p> <p>Benzene has a reported Kow = 2.13. In fish, metabolites may be detected in fatty tissues, liver, and brain.</p>
Mobility:	<p>Benzene migrates in soils and in ground waters. Airborne levels of benzene can be reduced by rain or water spray.</p>
Persistence and degradability:	<p>Benzene in air will photo-degrade with a calculated half-life of 13.4 days – this is accelerated in polluted atmospheres that contain nitrogen or sulphur oxides. By-products include phenol, nitrophenols, nitrobenzene, formic acid and peroxyacetyl nitrate. Benzene will biodegrade in soils and ground waters (half-life 16-28 days) under aerobic conditions. Limited degradation occurs under anaerobic conditions. Sewage treatment plants have been shown to remove 44-100%.</p>
Other adverse effects:	

13. DISPOSAL CONSIDERATIONS

Disposal of product:	Disposal must be done as a territory and/or local government regulations to ensure materials are handled appropriately and meet all criteria for disposal of hazardous waste.
Disposal of packaging:	As state or province regulations.



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14. TRANSPORT INFORMATION

Land transport:	SHIPPING NAME : BENZENE UN NUMBER : 1114 HAZARD CLASS : 3 PACKAGING GROUP : II REQUIERD LABELS : FLAMMABLE LIQUID
ADR/RID:	Class: HAZARD CLASS :3
Maritime transport:	SHIPPING NAME : BENZENE UN NUMBER : 1114 HAZARD CLASS : 3 PACKAGING GROUP : II REQUIERD LABELS : FLAMMABLE LIQUID
Air transport:	SHIPPING NAME : BENZENE UN NUMBER : 1114 HAZARD CLASS : 3 PACKAGING GROUP : II REQUIERD LABELS : FLAMMABLE LIQUID

15. REGULATORY INFORMATION

Hazardous label(s):	Hazard class : 3 Hazard labels : flammable liquid IB having a flash point lower than 22.8 °C and having a boiling point above 37.8 °C Highly toxic, HUMAN CARCINOGEN Irritating substance
Safety phrases:	Target organ phrase S 45 In case of accident or if you feel unwell, seek medical advice Immediately (show the label where possible). S 53 Avoid exposure – obtain special introductions before use.
Risk phrases:	R 11 Highly flammable. R 45 May cause cancer. R 48/23/24/25 Toxic: danger of serious damage to health by prolonged Exposure through inhalation, in contact with skin and if swallowed. (R11,R23,R24,R25,R36,R38,R45,R48,R65)

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16. OTHER INFORMATION

DANGERS: FLAMMABLE! TOXIC! CANCER HAZARD!



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